

Fish Protection Technologies for Existing Cooling Water Intake Structures and Their Costs

by

Ned Taft, Tom Cook, Jon Black, and
Nate Olken

Alden Research Laboratory

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to Protect Aquatic Organisms

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Proposed Performance Standards

- Reduce impingement mortality by 80 to 95 percent
- Reduce entrainment by 60 to 90 percent

Types of Site-Specific Factors

- Biology
- Hydraulic / Hydrodynamic
- Fouling
- Geotechnical
- Navigation and Space Requirements
- Climate

Examples of Site-Specific Factors that Influence Cost

- organisms to be protected
- flow
- debris
- biofouling
- silt
- facility type (nuclear vs. fossil)
- ambient current
- waves
- icing
- waterbody type
- water depth
- navigation and space issues
- substrate

Technology Categories

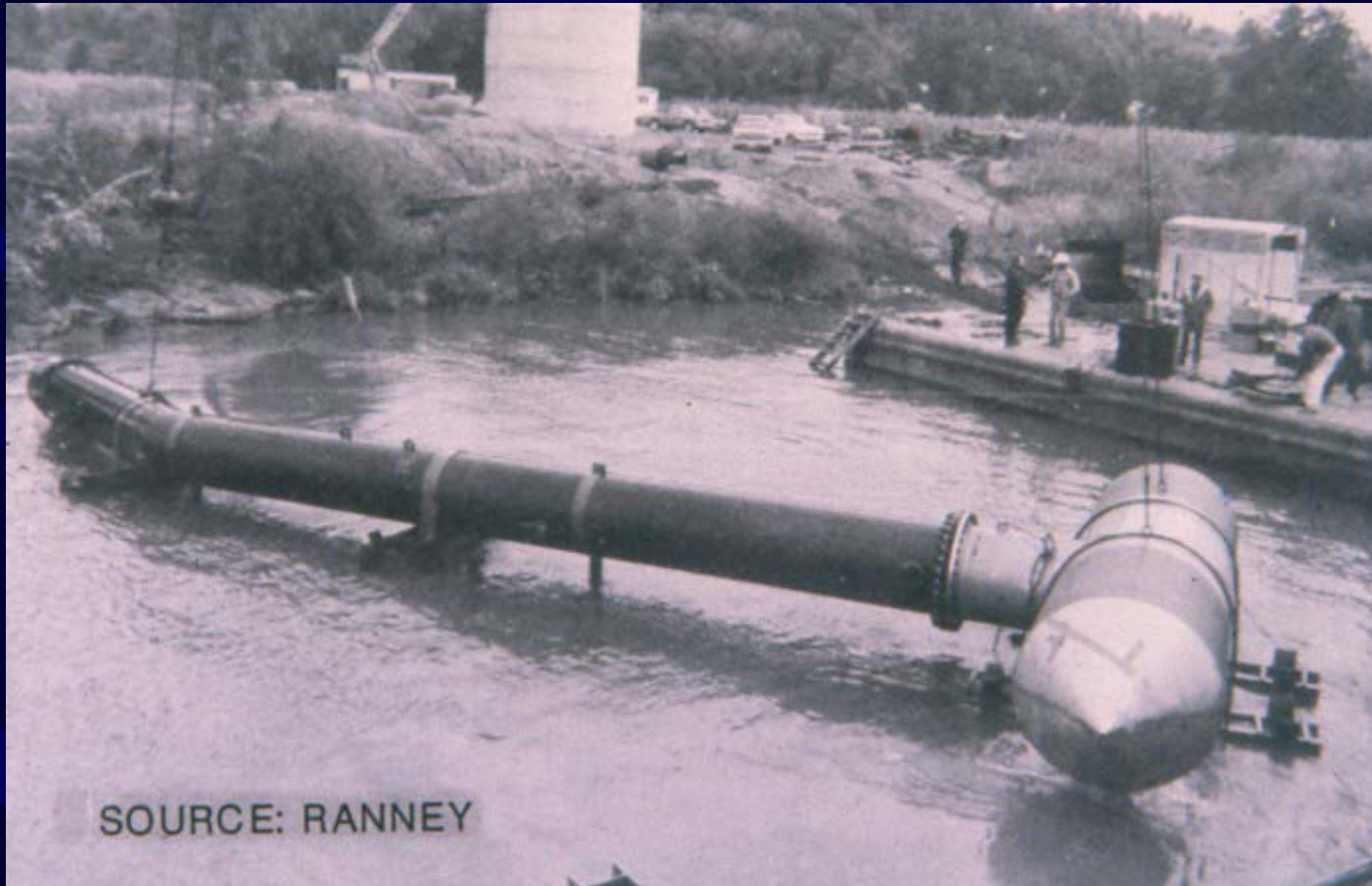
- Physical Barriers
- Collection Systems
- Diversion Systems
- Behavioral Barriers

Technologies EPA Considers Having Potential for Meeting the Standards

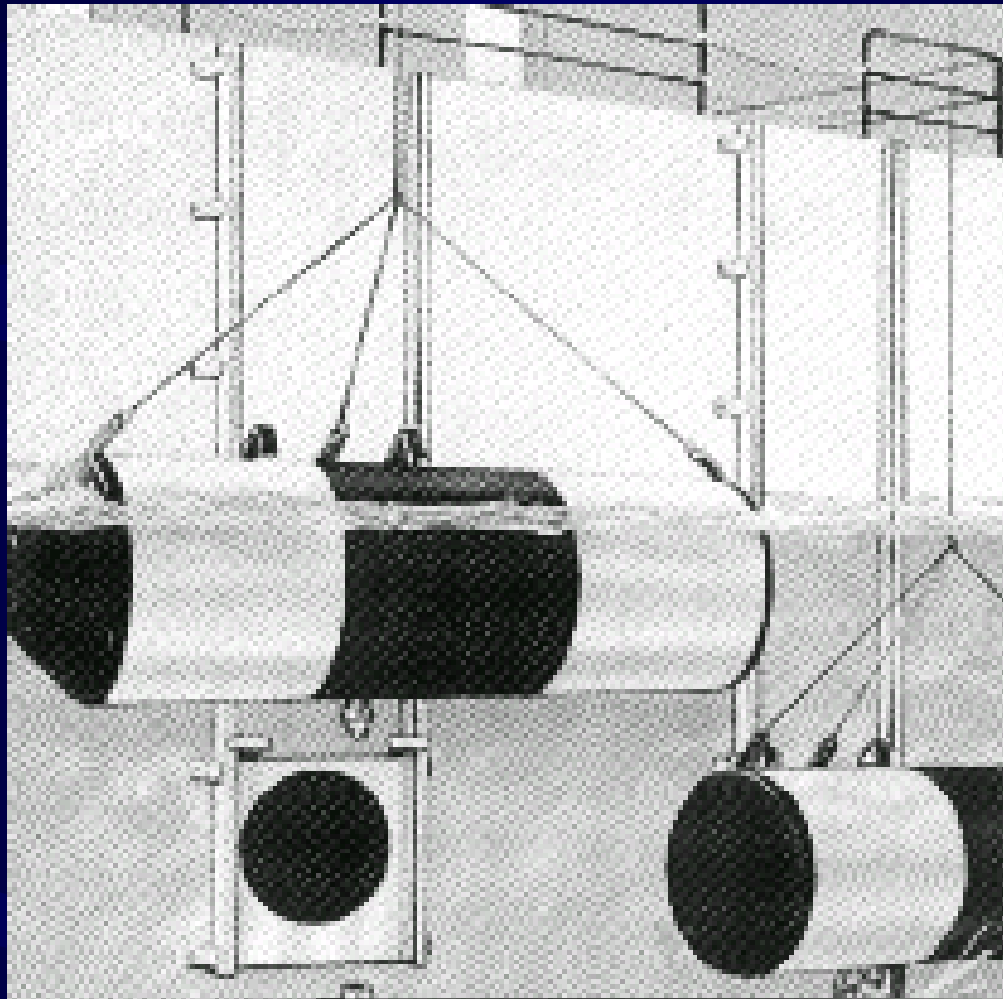
- Wedge Wire Screens
- Aquatic Filter Barrier (AFB)
- Modified Traveling Screens with Fish Return
- Barrier Nets
- Velocity Caps

Physical Barriers

Wedge Wire Screen



Schematic of Wedge Wire Screens Eddystone Station



7-foot Diameter Wedge Wire Screen



Courtesy of Johnson Screen

Status of Wedge Wire Screens

- Can be used to meet both the I and E standards
- Extensive existing performance data
- No large flow fine mesh installations

Wedge Wire Costs

EPA Cost = \$0.2 – 23M

Site-Specific Cost = \$3.5 – 144M

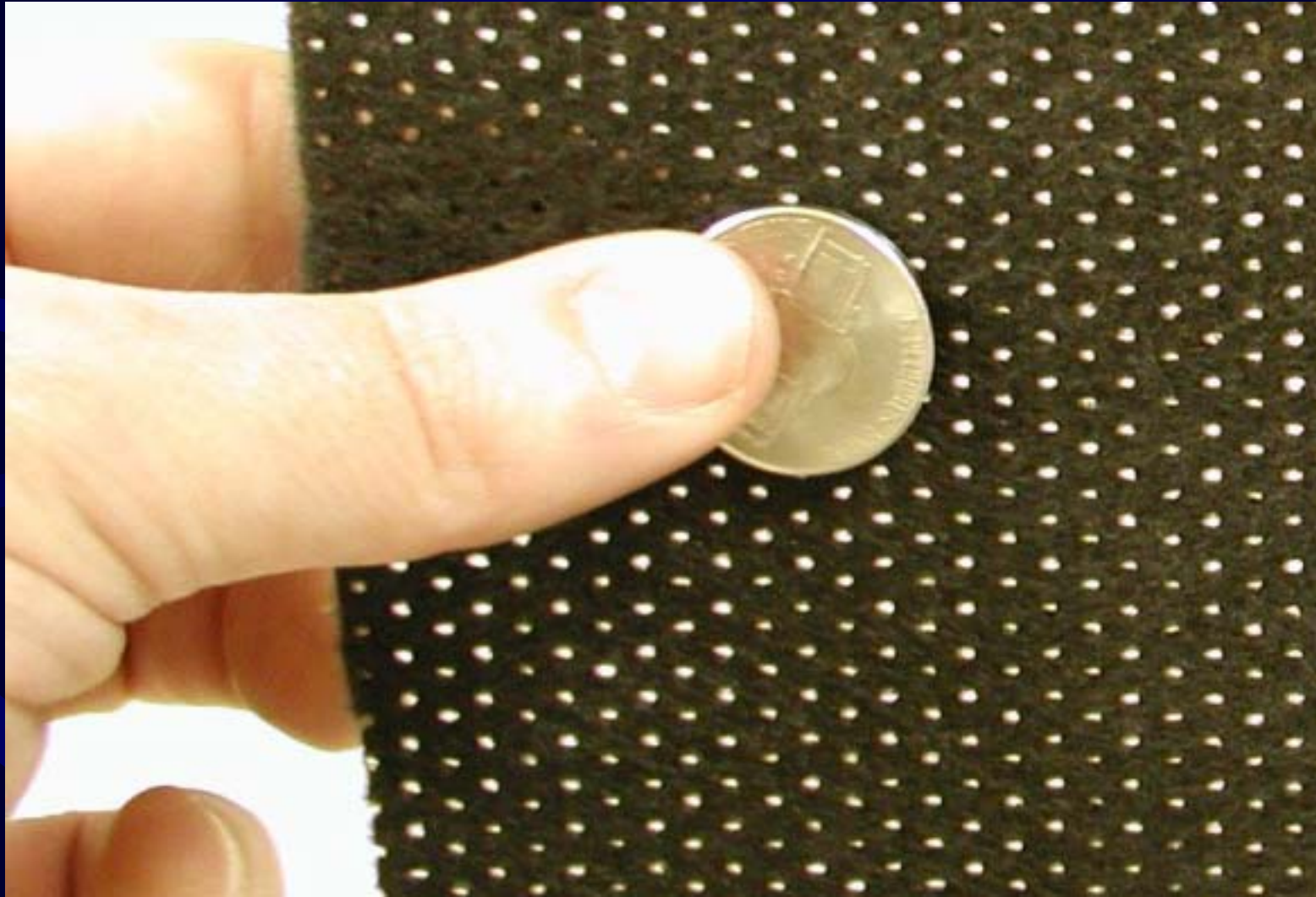
Examples of Site-Specific Factors that Drive Cost

<u>Factor</u>	<u>Impacts</u>
species / lifestage	slot size
flow (slot size)	number of screens
space and water depth	amount of piping
current site config.	location
biofouling	screen material

AFB – Deployed at Lovett



AFB - Perforations



Status of Aquatic Filter Barrier (AFB)

- Can be used to meet both I & E performance standards
- Limited performance data
- Currently limited to 10 gpm/ft²
- Requires large surface area

AFB Costs

EPA Cost = \$0.8 – 3M

Site-Specific Cost = \$9 – 72M

Examples of Site-Specific Factors that Drive Cost

Factor

species / lifestage

flow (perf. size)

currents and waves

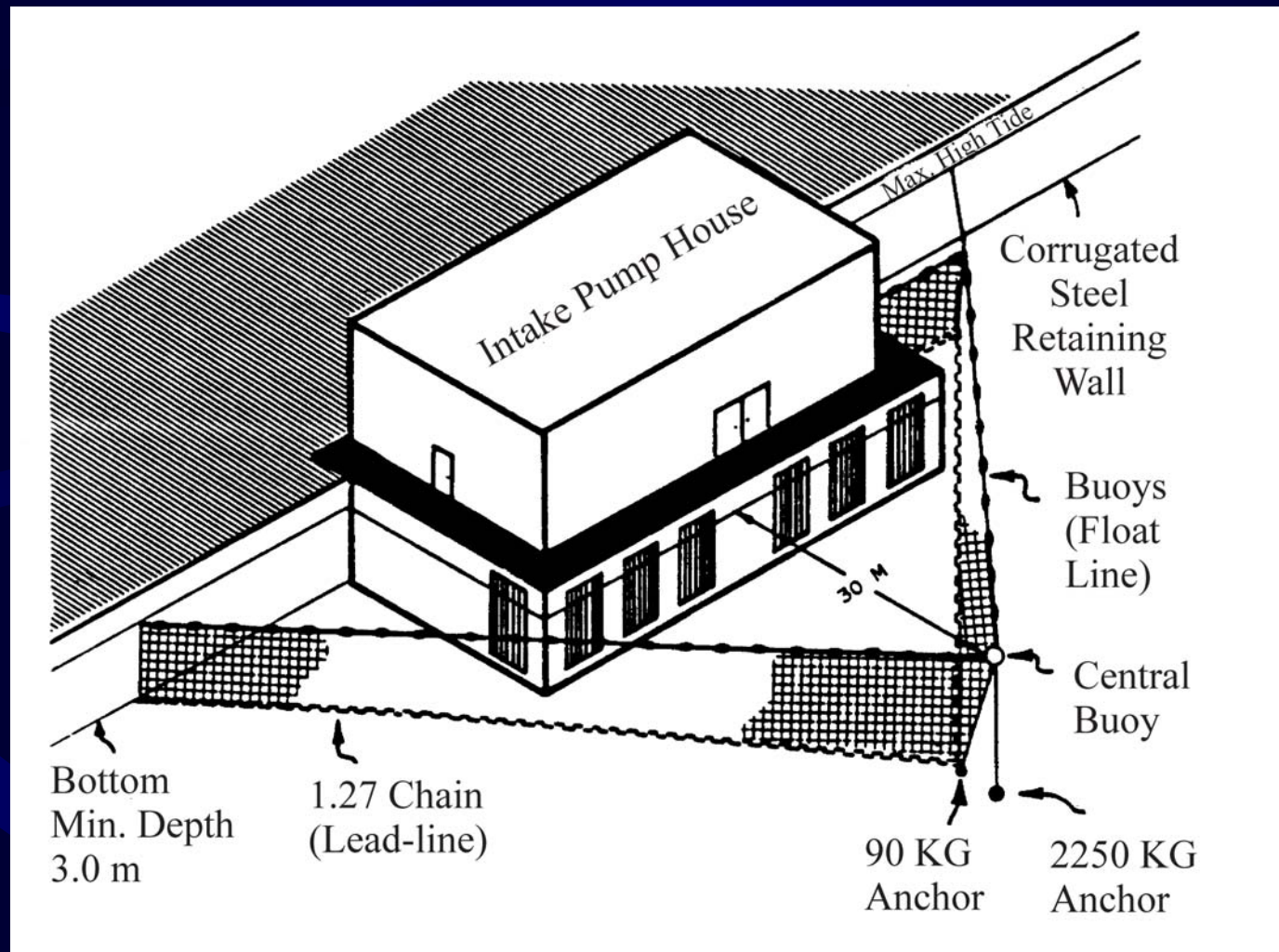
Impacts

perforation size

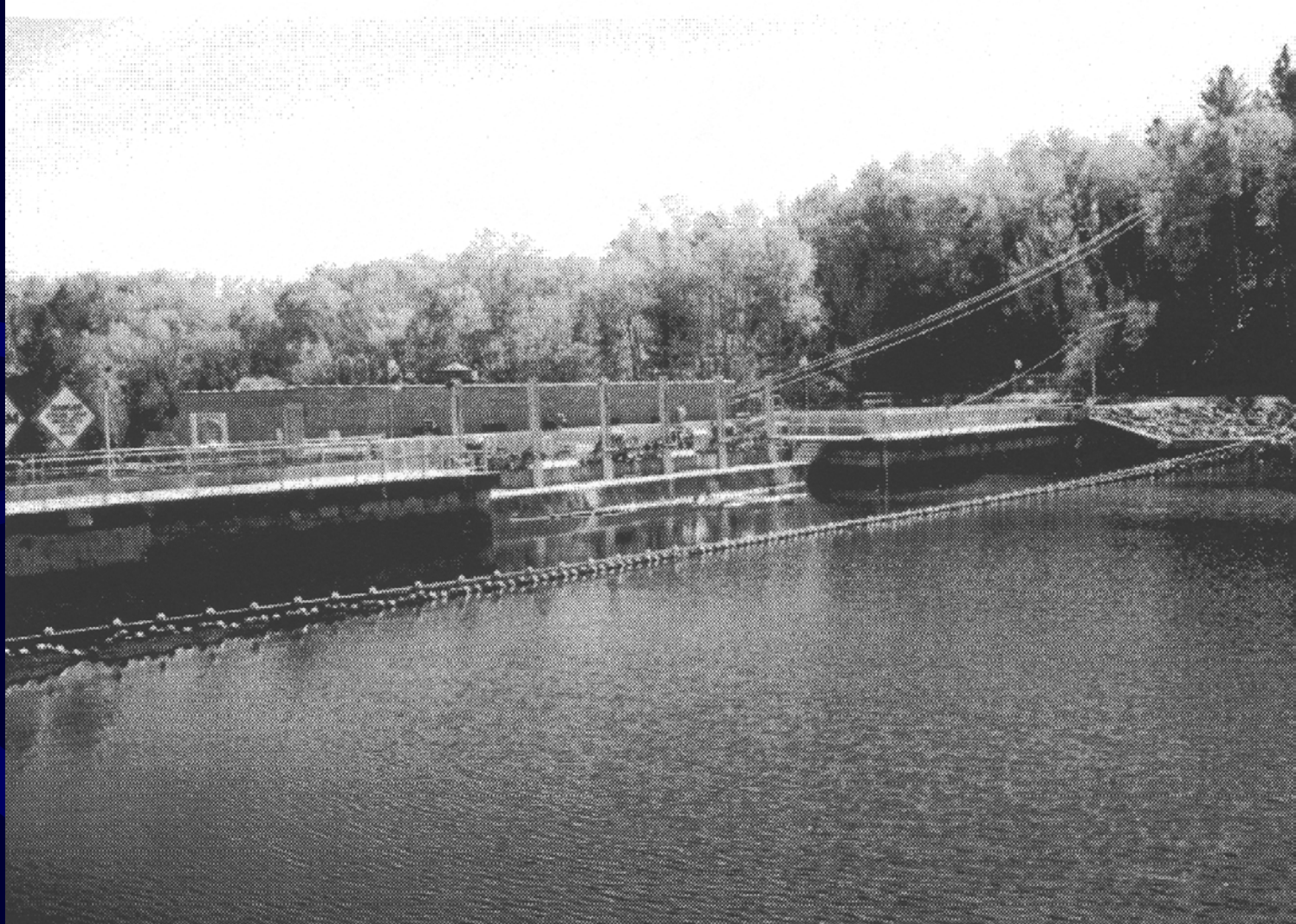
amount of material

support systems

Bowline Barrier Net



Brule Barrier Net



Courtesy of Dave Michaud

Status of Barrier Nets

- Can be used to meet the I standard
- Performance data exists
- Species and lifestage dictates mesh size

Barrier Net Costs

EPA Cost = \$0.013 – 0.063M

Site-Specific Cost = \$0.1 – 14M

Examples of Site-Specific Factors that Drive Cost

Factor

flow

current and waves

extent of fouling

Impacts

net area

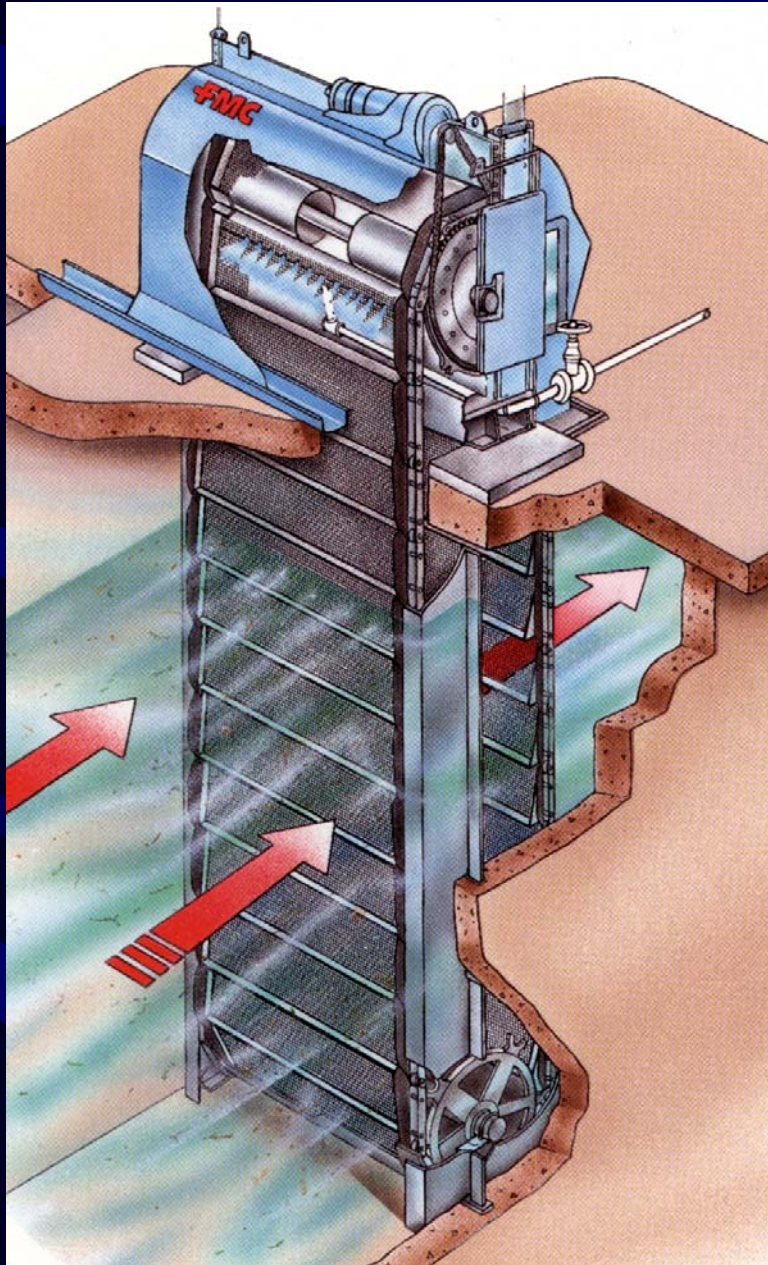
support systems

support systems

Summary of Physical Barriers

- Wedge wire screens and AFB have the potential to meet the I & E performance standards
- Barrier nets are a viable alternative for meeting the I standard
- Site-specific factors affect applicability, biological effectiveness, and costs

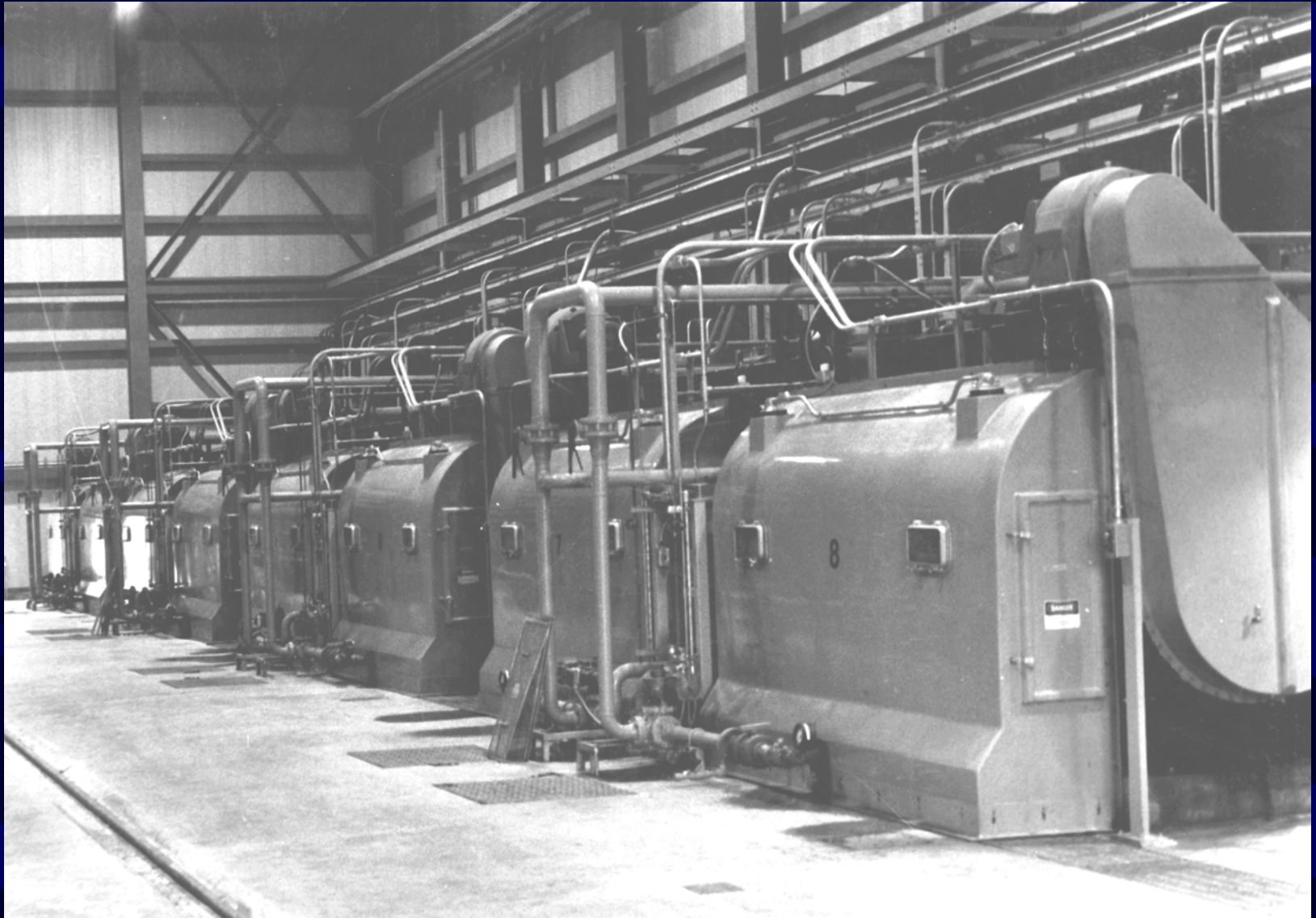
Collection Systems



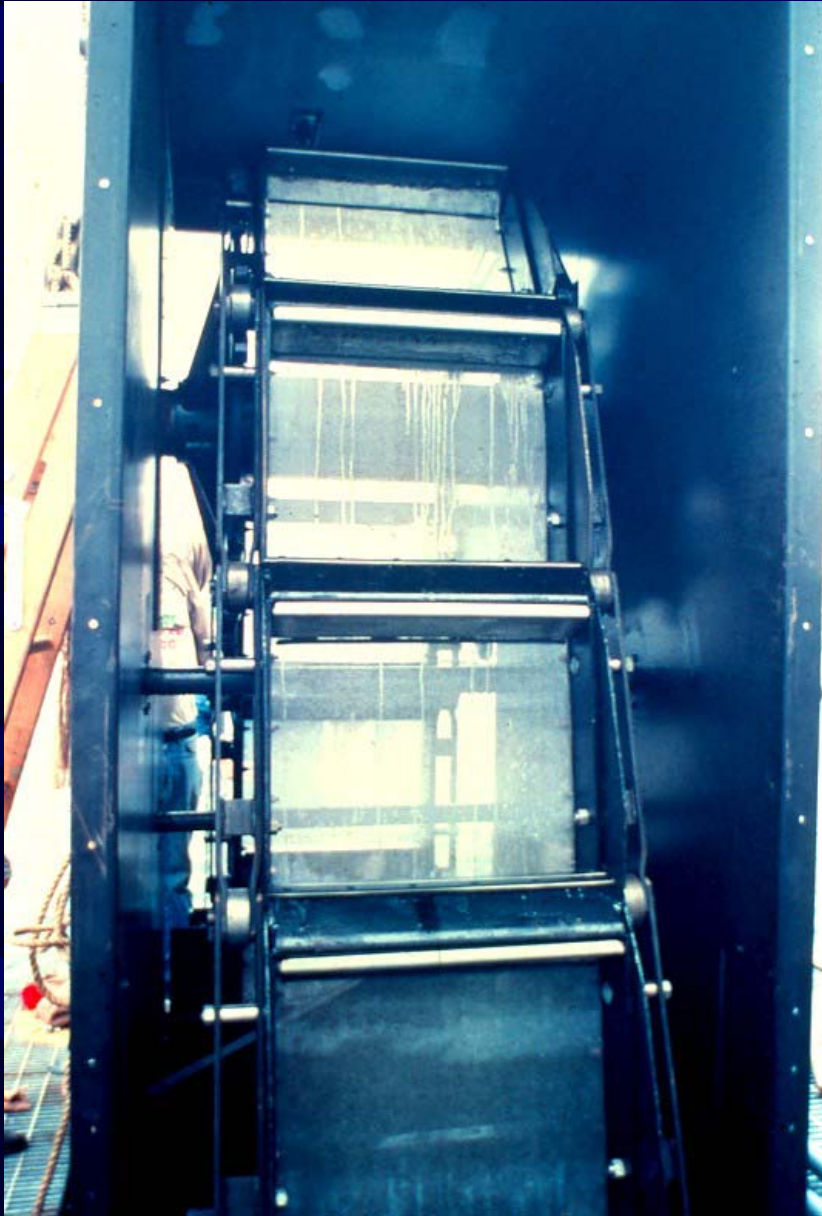
Modified Traveling Water Screens



Courtesy of USFilter



Prairie Island Fine Mesh (0.5 mm) Screens



Pilot Scale Fine Mesh Screens – Big Bend

Status of Modified Traveling Screens

- Coarse mesh modified screens can be used to meet the I standard
- Fine mesh screens can be used to meet both the I & E standards
- Substantial data exists on effectiveness and costs
- E Survival ?

Modified Traveling Screen Costs

EPA Cost = \$0.1 – 22M

Site-Specific Cost = \$0.3 – 44M

Examples of Site-Specific Factors that Drive Cost

Factor

through-screen velocity

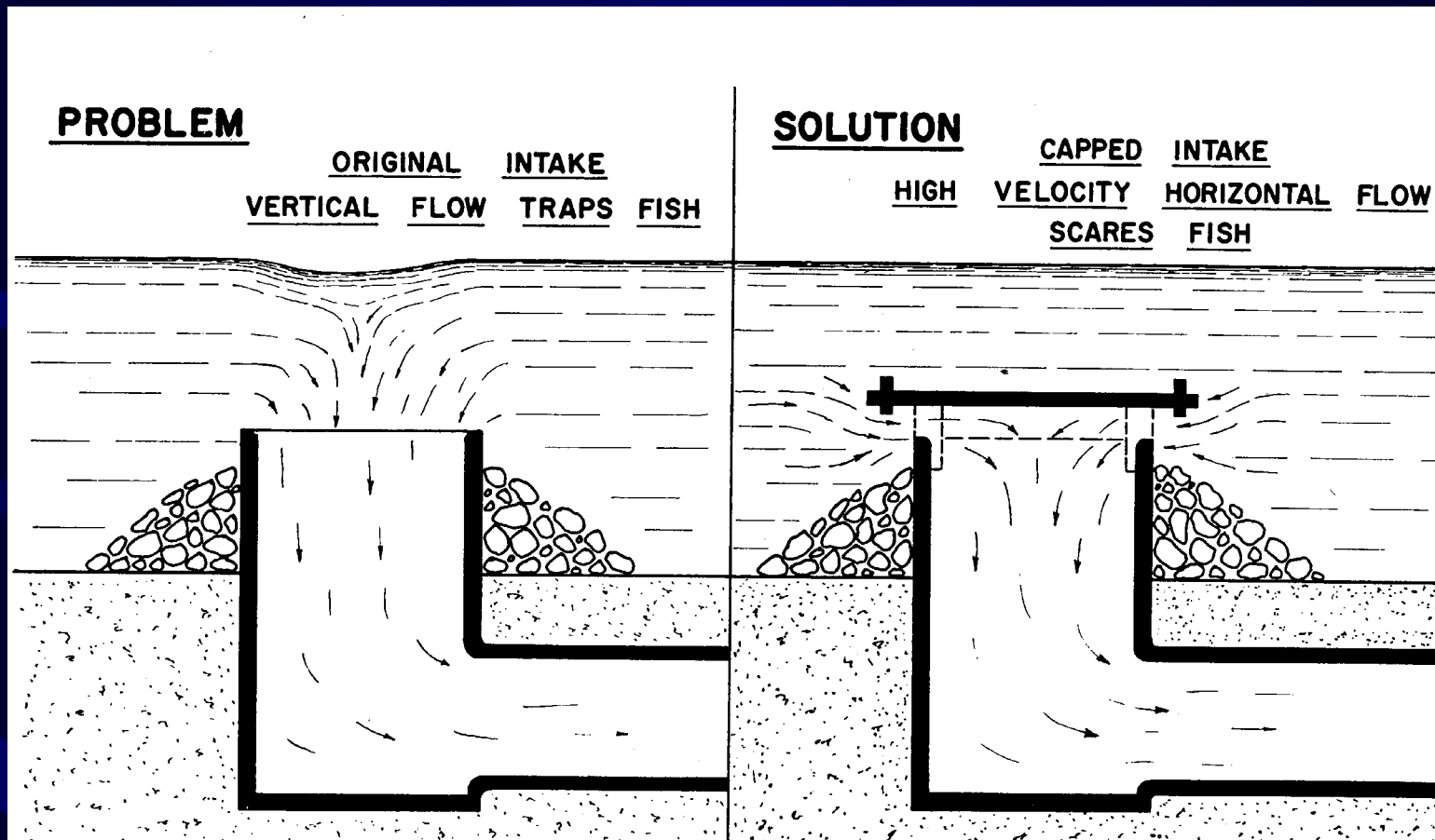
current screen area

Impacts

number of screens

expand intake?

Velocity Caps



Status of Velocity Caps

- Limited biological effectiveness data
- May have benefits associated with location
- No site-specific cost data

Review of Site-Specific Factors that Influence Cost

- organisms to be protected
- flow
- debris
- biofouling
- silt
- facility type
(nuclear vs. fossil)
- ambient current
- waves
- icing
- waterbody type
- water depth
- navigation and
space issues
- substrate

Comparison of Costs

<u>Technology</u>	<u>EPA Cost</u>	<u>Site-Specific Cost</u>
Wedge Wire Screens	\$0.2 – 23M	\$3.5 – 144M
AFB	\$0.8 – 3M	\$9 – 72M
Barrier Nets	\$0.013 – 0.063M	\$0.1 – 14M
Modified Screens	\$0.1 – 22M	\$0.3 – 44M

Conclusions

- Several technologies are currently available to meet the I & E standards
- Site-specific factors will determine:
 - the applicability of a technology
 - the biological efficacy of a technology
 - the costs of installing and operating a technology

Questions?

